NASA's Space Shuttle *Discovery* is one important step closer to launch. *Discovery* was rolled from its hangar early in the morning of March 29 to the Vehicle Assembly Building (VAB). *Discovery* will be attached to its propulsion elements, a redesigned External Tank (ET) and twin Solid Rocket Boosters (SRBs) at NASA's Kennedy Space Center, Fla.

NASA's *Discovery* rolls to major return to flight milestone

"THIS IS A TREMENDOUS ACCOMPLISHMENT

for the Space Shuttle Program," Bill Parsons, Space Shuttle Program Manager, said. "This effort has taken a talented team dedicated to meticulously preparing the vehicle and implementing all the modifications for a safe Return to Flight."

Discovery's launch window is from May 15 to June 3. Its mission, designated STS-114, will take Commander Eileen Collins and six crewmembers to the International Space Station. The mission is the first of two test flights to check out new inspection and repair techniques, as well as to deliver supplies to the Station. It is the first Shuttle mission since the *Columbia* accident in Feb. 2003.

Discovery's journey began as it was moved from its hangar to the VAB. In the VAB, a lifting sling was attached to the orbiter in preparation for attachment to the ET and twin SRBs. Work on *Discovery* in the VAB includes installation of a new digital camera, testing electrical and mechanical attachments between the orbiter and ET and umbilical checks.

"I could not be more proud of the team that spent the last two years working on *Discovery*. We are extremely excited to reach this point in the processing for flight," Stephanie Stilson, NASA Vehicle Manager for *Discovery,* said. "Seeing the orbiter roll to the VAB is the culmination of all of that hard work. We look forward to a safe Return to Flight."

While in the Orbiter Processing Facility, *Discovery* underwent 41 modifications in response to the *Columbia* accident and the recommendations of the *Columbia* Accident Investigation Board. They included addition of the new Orbiter Boom Sensor System; equipping the orbiter with cameras and laser systems to inspect the Shuttle's Thermal Protection System (heat shield) while in space; sensors in the leading edge of the Shuttle's wings, a new safety measure that monitors the orbiter's wings for debris impacts; and a new digital camera to view the ET during launch.

Discovery also completed its Orbiter Major Modification (OMM) period that began in Sept. 2002. Technicians completed 107 additional modifications to *Discovery*, 17 will be flying for the first time. OMMs are scheduled at regular intervals to enhance safety and performance and to infuse new technology.

The next Return to Flight milestone, currently scheduled for the first week of April, will be when *Discovery* begins its four mile journey to Launch Pad 39-B.

NASA KSC-05PD-0488

NASA KSC-05PD-0490

Above: One of the orbiter Discovery*'s payload bay doors is nearly upright as it closes. Seen in the center and at left are the new Orbiter Boom Sensor System (OBSS) and the Remote Manipulator System. The OBSS is one of the new safety measures for Return to Flight, equipping the orbiter with cameras and laser systems to inspect the Shuttle's Thermal Protection System while in space.*

Left: Workers show their support as the orbiter Discovery *slowly rolls out of the Orbiter Processing Facility bay 3 to begin its transfer to the Vehicle Assembly Building.*

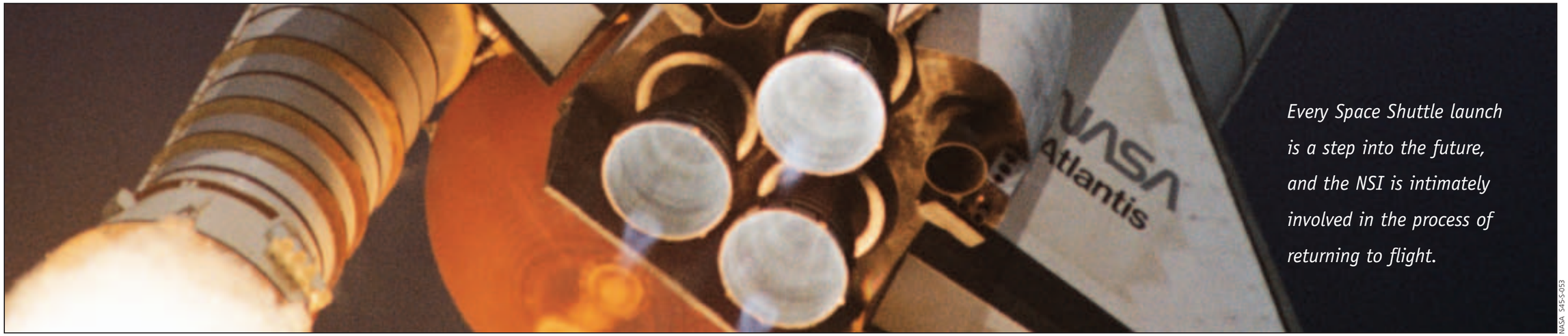
NASA KSC-05PD-0491

The orbiter Discovery *rolls over to the Vehicle Assembly Building, marking a major milestone in the march to Return to Flight.*

All fired up!

JSC pyrotechnics propel space exploration

by Catherine E. Borsché



Every Space Shuttle launch is a step into the future, and the NSI is intimately involved in the process of returning to flight.

NASA S45-S053

What device not only sparks the imagination of engineers but also ignites the pyrotechnic chain of events that powers the Space Shuttle? The NASA Standard Initiator (NSI) does this and much more for the space program. Considered the world standard for electro-initiated explosives, NSIs are small explosive devices used in the Shuttle, Mars Exploration Rovers and many Jet Propulsion Laboratory (JPL) planetary probes.

"The NSI is basically the electric match that starts it all," Todd Hinkel, subsystem manager for Orbiter Pyrotechnics, said.

It's easiest to think of the NSI as a mini explosive. Each NSI contains a bridgewire, which is a tiny piece of metal used to conduct electric current into the device.

"To make the NSI go off, you send current through that bridgewire," Keith Van Tassel, group lead for Johnson Space Center Pyrotechnics, said. "It gets so hot that it melts, and there's enough heat from that melting to ignite the propellant that's around it."

And, in roughly 300 microseconds, the NSI detonates.

"Generally, we use pyrotechnic events for a one-shot function. If you want to push or pull on something just once, then the amount of energy and the amount of volume taken up by a pyrotechnic device is much more efficient than using hydraulics or an electric motor," Van Tassel said.

The efficiency of the NSI, as well as its stellar performance throughout the history of the space program, makes it a popular choice for engineers.

"The NSI is an extremely robust device that has an operational temperature range of +300 degrees to –420 degrees Fahrenheit," Hinkel said. "We've had approximately 10,000 successful firings on the Shuttle. We've even had tens of thousands of successful firings if you take it back to the Apollo era and consider the other vehicles and unmanned craft that have used NSIs."

Currently, the Space Shuttle is NASA's largest NSI customer. A total of 137 units are flown on each mission, with 102 fired during a normal flight. The remaining NSIs are installed for emergency situations where deployment or separation is needed for immediate use.

NSIs are prevalent in JPL's crewless programs as well.

"In the case of the Mars rovers, most of the NSIs were used during the landing phase. Some were used to slow the descent, jettison the heat shield, deploy parachutes and then cut away the parachutes. They were also used to inflate and deflate the balloon air bags," Van Tassel said. "Once the rover was stabilized on the ground, there were some NSIs that fired pyrotechnics to cut wires and release the rover from the pad."

JSC has the distinct responsibility of logistics management, manufacture and certification of NSI for government-wide consumption. JSC is also the only NASA facility capable of performing the –420 degree Fahrenheit functional tests to evaluate the hardware.

"NSIs are deceptively simple, but there's a lot of work and technology that goes into making sure they work right and are so reliable," Van Tassel said.

The rigorous testing done at JSC is just a part of what makes NSIs so safe.

"The testing at –420 (degrees Fahrenheit) weeds out manufacturing defects," Hinkel said. "We are very abusive to our devices before they get put on a NASA flight."

Another important safety feature is that there is always a backup NSI in case one does not fire. The redundancy built into the system is designed to provide a safety net if in fact an NSI does happen to fail.

Every Space Shuttle launch is a step into the future, and the NSI is intimately involved in the process of returning to flight.

"We are there from the start of the mission to the finish, from lighting the Solid Rocket Boosters to finally releasing the drag chute at the end of the mission," Hinkel said.

There is no question why these small wonders are so inherently tied to space exploration.

"Basically, when you want something that you know is going to be reliable, you ask for the NSI," Van Tassel said.